

Using the enhanced loading capacity of Cargill's FR3® fluid immersed transformers to optimize inventory.

The increased thermal class of paper immersed in Cargill's FR3® fluid allows for a relevant additional permanent overloading capacity, a "reserve capacity" that expands the application range of the transformers.

For same operating temperatures, paper degradation rate is 7.4x lower for thermally upgraded kraft paper (TUK or TUP). Alternatively, the same degradation rate is reached when the operating temperature is increased in 20°C. The additional degrees will offer an "above nameplate" capacity without accelerated degradation, named as "sustainable peak capacity".

The required minimum efficiencies, typically, lead to transformer not reaching specified temperature limits. So, there is some embedded "capacity reserve", as nominal life happens at a loading above rated.

Exploring these aspects allows designing "dual rated" transformers. Such units have a rated capacity, at conventional temperatures, and as additional loading capacity for higher temperature limits. Two different options for combining SKUs are possible. The system will verify both and suggest the best one.

Option A →

| Standard kVA values | FR3 fluid Dual Rating 1φ | Standard kVA values | FR3 fluid Dual Rating 3φ |
|------------------------|--------------------------|---------------------------|--------------------------|
| 10kVA 1φ 15kVA 1φ | 10/15 kVA | 30 kVA 3φ 45 kVA 3φ | 30/45 kVA |
| 25kVA 1φ 37.5kVA 1φ | 25/37.55 kVA | 75 kVA 3φ 112.5kVA 3φ | 75/112.5 kVA |
| 50kVA 1φ 75kVA 1φ | 50/75 kVA | 150 kVA 3φ 225 kVA 3φ | 150/225 kVA |
| 100kVA 1φ 167kVA 1φ | 100/167 kVA | 300 kVA 3φ 500 kVA 3φ | 300/500 kVA |
| 250kVA 1φ 333kVA 1φ | 250/333 kVA | 750 kVA 3φ 1000 kVA 3φ | 750/1000 kVA |

Option B →

| Standard kVA values | FR3 fluid Dual Rating 1φ | Standard kVA values | FR3 fluid Dual Rating 3φ |
|------------------------|--------------------------|----------------------------|--------------------------|
| 15kVA 1φ 25kVA 1φ | 10/15 kVA | 45 kVA 3φ 75 kVA 3φ | 45/75 kVA |
| 37.5kVA 1φ 50kVA 1φ | 25/37.55 kVA | 112.5 kVA 3φ 150 kVA 3φ | 112.5/150 kVA |
| 75kVA 1φ 100kVA 1φ | 50/75 kVA | 225 kVA 3φ 300 kVA 3φ | 225/300 kVA |
| 167kVA 1φ 250kVA 1φ | 100/167 kVA | 500 kVA 3φ 750 kVA 3φ | 500/750 kVA |

Differently from a "standardization" process, where a larger transformer replaces a smaller one, the concept is to extend the application range of the smaller one.

Since peak capacity is only reached a few hours per day, some days per year, the balance of the reduction of the no-load losses 24/7 and the increase of the load losses during peak may lead to an equivalent or even lower value of dissipated energy. USA DOE reports (Department of Energy) from 2019 indicated yearly RMS average load of distribution transformers to be around 30%, while the optimum would be 50%. So, this approach improves the transformer utilization, getting closer to best efficiency and asset utilization.

Reduction of inventory

It is a common practice to add about 15% of "margin" on the number of units to be purchased per year for each SKU. When SKU's are combined, this reserve is only added to the item having more consumption, not to the total. The quantity of purchased transformers will be thus reduced.

Financial assumptions

For illustrative purposes, some reference costs for each transformer was assumed. Starting from an estimated price in the middle of the range, the price of other rated capacities was calculated proportionally to the square root of the capacity variation, i.e., the price of a 75kVA was $\sqrt{75/50} = 1.225x$ the price of a 50kVA.

An additional assumption was that the price of the dual rating unit was 10% higher than the price of the base original rated capacity.

Expected benefits

This approach is expected to allow both reducing the number of SKU's and the average cost per kVA. In case you want to refine the values, Contact us - FR3fluid.com

This document is provided for your information and convenience only. All information, statements, recommendations and suggestions are believed to be true and accurate under local laws but are made without guarantee, express or implied. WE DISCLAIM, TO THE FULLEST EXTENT PERMITTED BY LAW, ALL WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE and FREEDOM FROM INFRINGEMENT and disclaim all liability in connection with the storage, handling or use of our products or information, statements, recommendations and suggestions contained herein. All such risks are assumed by you/user. The labeling, substantiation and decision making relating to the regulatory approval status of, the labeling on and claims for your products is your responsibility. We recommend you consult regulatory and legal advisors familiar with applicable laws, rules and regulations prior to making regulatory, labeling or claims decisions for your products. The information, statements, recommendations and suggestions contained herein are subject to change without notice.